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AN ADDRESS

DELIVERED AT THE

OPENING OF THE SECTION OF PUBLIC MEDICINE,

AT THE

Annual Meeting of the British Medical Association,

IN SHEFFIELD, AUGUST, 1876.

BY

J. B. RUSSELL, B.A., M.D.,

Medical Officer of Health to the City of Glasgow, President of the Section.

ROYAL · COLLEGE · OF · SURGEONS · OF · ENGLAND

PRESENTED
by the
AUTHOR.

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GENTLEMEN,—Although, fortunately for me, the usage of this Association does not impose upon the Presidents of Sections the duty of delivering an address in connection with their departments, still I am desirous, on the occasion of my first appearance before you as your President, to ask your indulgence for a few remarks. This I the more readily do, that the colloquial ease thus afforded me suits my want of leisure for the set phrases and connected thought of a paper.

The Glasgow Improvement Trust.

You are aware that I am medical officer of health for the city of Glasgow, and Glasgow is notorious for its unhealthiness and for the vigorous efforts being put forth by the local authority for its improvement; especially in the direction of clearing out and reconstructing the older and most unhealthy portions of the city. It is not my intention to repeat before you any details of the nature, extent, and operations of the Glasgow City Improvement Act (1866), which were fully narrated and discussed in the introduction and passage through the Houses of Parliament of the Artisans' Dwellings Act, and for which we certainly have had ample credit awarded. But the fact that there is now an imperial measure declaring that "various portions of many cities and burghs are so built, and the buildings thereon so densely inhabited, as to be highly injurious to the moral and physical welfare of the inhabitants," and enabling communities so situated, without the trouble and expense of a local Act, to institute improvement schemes, makes me think that a short statement of the more obvious results of our operations, and some remarks flowing therefrom on reconstruction, density, &c., may be useful to such of you as advise authorities or practise in communities who may take action under the general Act.

That portion of the city of Glasgow which was included in the powers of the Improvement Act of 1866 embraced about 88 acres, on which a population of 51,300 persons lived in upwards of 10,000 houses, using that word not in the structural sense attached to it in England, but in the social sense customary in Scotland, meaning that fraction of a building rented and occupied by one family. Although the Act was passed in 1866, the demolition of houses was not commenced to any important extent until 1870, the intervening years being devoted to the acquisition of the properties involved in the scheme. When such operations are carried out, the advantages anticipated are of two kinds—1, immediate; and 2, remote. In terms of the Act the extent of the demolition and displacement at any one time is defined by Section 28. Within six months no number of inhabitants exceeding 500 can be displaced without a certificate from the Sheriff of the County, granted on evidence, that accommodation exists or shall be provided for the inhabitants displaced. In Scotland the times of year when houses are let are May and November. The May term has been preferred for the greater part of the evictions and demolitions, being the summer, when least hardship is likely to arise. On two occasions, viz., in May, 1874, and May, 1875, a minute test of the *immediate* results upon the people displaced has been instituted. The investigation extended to 1169 families, containing 3710 persons. The houses were fair samples, situated in the oldest parts of the city, of the whole property to be dealt with, and their inhabitants were of that class of our urban population which is the source of so much trouble and anxiety to authorities of all kinds. I shall not trouble you with more than a general statement of results, merely adding this assurance, that they are not guesses or approximations, but based on accurate statistics. When a householder is summarily ejected from his house, and the house demolished, the necessary immediate results are manifested in changes as regards the size of his house, its rental, the readjustment of the number of inmates per house, the position of the house, relative to the centre of the city, and the facilities afforded for the disposal of the excreta of the inmates. Taking up those points in succession, the following are the immediate results of our action.

As to *size of house*, it would have been better had it been possible to state the cubic contents rather than the number of apartments; for, in reference to the comparative size as well as comparative rental, the words house and apartment, without further explanation, mean very different things as applied to the dwellings demolished and those into which the inmates removed. But, while 84 per cent. of the old houses were ticketed under the Glasgow Police Act, *i.e.*, their cubic contents were marked on the doors, with a statement of the corresponding number of inmates allowed, the majority of the new houses were not so ticketed, and consequently a sufficiently laborious inquiry would have been made still more so by the necessity of measuring those houses for the sake of comparison. After all, however, the result would have been merely to express in figures what, you may accept my assurance, is the fact, that the dwellings which those people were compelled to leave were, on the whole, so bad that it was impossible for them to find their equal or their like; and you may take it that the words house or apartment mean something more as applied to the new dwellings than to the old, more in the way of space, comfort, and convenience. You must keep this before your mind in interpreting the meaning of the following bare figures, and estimating the facts to which they give most meagre expression. We found 478 families occupying dwellings of only one apartment. Of these, 296 removed to dwellings of the same size, and 138 to larger, while 25 gave up householding and took to lodgings, 1 removed to the suburbs, 9 to the country, and 9 are otherwise accounted for by emigration, imprisonment, the poorhouse, &c. We found 330 families occupying dwellings of two apartments. Of these, 217 removed to dwellings of the same size, 34 to larger, and 68 to smaller; while 2 went into lodgings, 1 removed to the suburbs, and 1 to the country, leaving 7 to be otherwise accounted for. We found 62 families occupying dwellings of three apartments. Of these, 15 removed to houses of the same size, 8 to larger, and 33 to smaller; while 1 went to lodgings, 3 removed to the suburbs, and 1 to the country, leaving 1 to be otherwise accounted for. The remaining 28 families occupied dwellings larger than three apartments; and of these, 3 removed to houses of the same size, 1 to a larger, and 23 to smaller, leaving 1 to be otherwise accounted for. The general result is that only 13 per cent. of the families displaced by our operations removed to smaller houses, even if we estimate the comparative size on the rough basis of the number of apartments; while 20 per cent. removed to larger.

In a sanitary aspect the meaning of the size of a house depends upon the relation between the *number of the family* and the capacity of the house. Applying this test also, the results are satisfactory. Both in May, 1874, and May, 1875, it was found that the average number of inmates in the houses of one apartment into which those families assorted themselves was decidedly less than in those which they had left; that in houses of two apartments, also, the average number was less, though not so decidedly; while in houses of three apartments and upwards the numbers were considerably greater. All this is just as it should be. The operations left the families displaced living in houses better adapted to their numerical requirements than those in which it found them.

This fact is all the more important and gratifying when we turn to the matter of *rental*, and observe that of all the changes forced upon those people, that of increased expenditure for house-rent was the most decided, and very probably to themselves the greatest and most obtrusive. For every class of house there was an increase of rent, amounting to 20 per cent. on the old rental of a one-apartment dwelling in 1874, and 17 per cent. in 1875; to 20 per cent. on the old rental of a two-apartment dwelling in 1874, and 21 per cent. in 1875. The purely fictitious nature of the accommodation provided in these wretched dilapidated properties is made glaringly manifest by the comparative rental of the houses above two apartments. To say that a dwelling of three or four apartments could only be got in the new localities at an increase of 50 to 58 per cent. over the rental of the same size of dwelling in the old localities, is to misrepresent the case, and do an injustice to the honest landlord quite as great as would the quotation of the prices of the merchant of adulterated goods against those of the fair dealer. The same remark applies to the smaller houses, though not to the same extent. What would a house of one apartment be at 2s. 6d. or 3s. 6d. per month, or a house of two apartments at 5s. per month, or a house of three apartments at 5s. 10d. per month, or one of four apartments at 7s. 10d. or 8s. 6d. per month? Yet these are all quotations of rents actually paid. A house means something more than a hole. The burrow of a Bosjesman is not a house. But are there people in our large towns who can contribute no more monthly towards the provision of a dwelling place than such sums as these? If there be, then, for the public safety and for the sake of our civilization, philanthropy or taxation must provide for such; but my experience does not lead me to believe in their existence, except as the product of vice and improvidence. I invariably observe that in such hovels you do not find those who are poor from necessity of circumstance, but those who live by unlawful callings or who divert from their families and their houses every possible penny, in order to spend it in self-indulgence. In 1865, in his Report to the Privy Council on the Housing of the Poor in Towns, Dr. Hunter said: "From one point of view, crowding in Glasgow means the diversion of income from rent to supply whisky." The same remark, I have no doubt applies to the same class in all large towns.

Another item in the changed circumstances of those people which admits of numerical statement, is the method of *excrement disposal*. In 1874 we found that only 4½ per cent. of the families displaced had water-closets, the remainder using ashpits and privies. In their new abodes, 13½ per cent. were supplied with those conveniences. In 1875 the proportion was increased from 7 per cent. to 14 per cent by the compulsory change. Here, again, we must recall your minds to the improved conditions which cannot be expressed by bald figures. The ashpits and privies of the new localities are much more inoffensive and innocuous than in the old, where, from want of space, they were close to the dwelling-houses, often at the bottom of enclosures, which were simply pits or tanks, in which the foul effluvia stagnated, and surrounded by windows through which they passed freely into the houses. In the new localities, also, in 1874, 63 per cent., and in 1875, 45 per cent., of the water-closets were situated, not in the houses, but on the common stair; indeed, but for this I should hesitate to enumerate among the advantages of the change the fact that houses of this class were provided with water-closets. It is scarcely possible to find a position in a house of four or five apartments where a water-closet will not be a dangerous nuisance; and it is simply abominable to introduce such a thing into a house of three apartments or less. Apart from those objections on the ground of space and structure, there is this other of wider application, that a certain amount of culture and intelligence is necessary for the proper management of those social conveniences; and, wherever a water-closet is common property, as a rule it is abused: it is essentially suited only for the use of one family living in a self-contained house. In Glasgow, unfortunately, where we have proved that our Improvement Trust operations are increasing the proportion of our excretions which passes into the sewers, we have not seen the last of the nuisance. We are increasing the pollution of the Clyde beyond the increase proportioned to the growth of our population: but, after all, in relation to public health, it is a question of degree. On the one hand, we have the filthy ashpit or privy in our confined courts and yards; and, on the other, the filthy river flowing through a long open space, and exposed freely to the open air. Still, it is not a case of "How happy should we be with either," but how gladly would we part with both.

The last of the immediate and numerically measurable results of our demolitions is their effect in accomplishing the *dispersion of our population* more equally over the area of the city. We shall discuss the matter of density and its relations to health immediately; but meanwhile we shall assume that the expulsion of masses of the community from the centre outwards is at once to effect an improvement in their general hygienic position. We must go down into the city to earn our bread, but the nearer to the outer verge we can sleep and rear our families, the better in the aggregate. The Cross may be taken as the centre of the city of Glasgow, being almost equidistant from all points of the municipal boundary, and also the nucleus round which the city has grown—the oldest, most densely inhabited, and most unhealthy part of it. The general result of our investigations in 1874 was that before our operations only 27 per cent. of the families displaced lived beyond half a mile from the Cross, but that afterwards no less than 60 per cent. were dispersed to various stages beyond that distance, two per cent. flowing over into the suburbs. In 1875 we found that, as in the former year, before being disturbed, only 27 per cent. lived outside a circle at half a mile radius from the Cross, but that afterwards 54 per cent. had settled down outside that circle, 1 per cent. having gone to the suburbs. In each year the crest of the wave of dispersion was at the three-quarter mile circle from the Cross. If we confine our attention solely to the families primarily displaced, the internal movement resembles that of a wave gathering up to a crest, then breaking and flowing outwards in a diminishing stream; but if we have regard to all the units of the population in whose midst this commotion takes place we shall discover a process of displacement and substitution whose only limits are the very outer confines not merely of that which is artificially termed Glasgow, but of that great community of which Glasgow is the vital centre. Those people go into cast-off houses just as they wear cast-off clothes, and the demand is met by "making-down" houses, converting one large into a cluster of small, a process to which I shall not allude further than to say that it is rapidly reproducing the evils to get rid of which we are expending so much money.

Such are all the facts capable of statistical expression which I can adduce concerning the sanitary results of the Glasgow Improvement Act. They are, you will observe, facts concerning the very people whom the operations of the Act immediately affect, and they are the immediate effects upon those people. As to the ulterior effects upon the health of those people, and upon the health of the general community, I am not yet able to speak. A necessary condition of all effects upon health is time. On general principles, we believe that all the changes to which I have given numerical expression are of a nature to benefit the citizens involved in those changes; but for the manifestation of those benefits, until they also admit of statistical expression, time for their development is absolutely essential. It seems to me they have begun to show themselves, but it would be premature to appeal to figures in proof of our belief.

I may, however, allude shortly to other procedures under the Improvement Act which have been adopted in the direction of the amelioration of the unhealthy conditions of city life. The first of these is the provision of *common lodging-houses.* In the course of our investigations we found that between 3 and 4 per cent. of the families displaced went into lodgings. The keeping of lodgers is quite a feature of small householding in Glasgow, and a very unpleasant one it is, both in its social and its sanitary aspects. At the census of 1871, it was found that 23 per cent. of all the families kept lodgers, and the practice prevails among those who must necessarily sacrifice both decency and health in the exercise of it. Even of families living in one apartment, 14 per cent. had lodgers, and of those in two apartments, 27 per cent. As three-fourths precisely of all the dwellings in the town are of that size, you will understand what an important element in the community in every aspect is the unattached lodging population. To my mind the introduction of lodgers into the family circle of those small houses is to be regretted and discouraged. In a one-apartment house it is simply abominable to contemplate; and in all cases the close personal contact and the want of privacy either of the general or family functions which must prevail are made doubly injurious, morally, by the introduction of strangers, besides the physical injury of overcrowding. Of this lodgers are the frequent cause, being crammed into houses which, without them, would afford tolerably decent and wholesome accommodation to the natural inmates. Hence, as the Registrar-General for Scotland pointed out in his Report on the Census, "the larger house for the operative, built with a view of effecting the better separation of the sexes, is in reality found to have no such effect; but, on the other hand, holds out an inducement to him to crowd his family to a greater extent than when he occupies a house of one or two rooms" (vol. i., p. 35). In destroying those fictitious houses, let at nominal rents, which I have described, the Improvement Trust were adding to that vagrant class of people who occupy common lodging-houses, and for them only did they of themselves provide accommodation in the shape of large lodging-houses, with day rooms, lavatories, and every convenience, where each has a separate bed, and the use of a cooking-range and utensils, at the charge of 3½d. per night. They are each under a superintendent, and are kept in admirable order. They are self-supporting, and return 5 per cent. on the capital expended. From this we may have some idea how lucrative the lodging-houses provided by private enterprise must be.

Provision of Dwellings for the people displaced.

Now we come to the most important branch of all improvement schemes, the reconstruction, the *provision of dwellings for the people displaced,* and their supervision so as to check the upgrowth of like errors of plan and occupation. In a memorandum addressed to Mr. Secretary Cross, and contained in papers presented to Parliament before the introduction of the Artizans' Dwellings Bill, the sub-convener of our Trust (Bailie Morrison) says—"We do not build houses, as a sufficient number of these are erected by private enterprise to meet all the wants, and no case of real hardship is known. . . . . . We are opposed to competing with private enterprise, as such a course checks building. Neither do we consider it prudent to become philanthropic landlords, to let houses below the actual rents to any class, as this has a decided tendency to pauperize and destroy that feeling of independence in our working-class population to which they are already too prone." I do not question the propriety of this decision, to leave the demands of a public necessity to the action of the ordinary law of supply on commercial principles; but it ought to be an essential condition of such a decision on the part of a local authority carrying out such operations, that they have the power of impressing upon the new building of the present all the sanitary lessons of the past: that in short, they should have a liberally constructed Building Act. This we unfortunately do not possess in Glasgow, as is sufficiently manifested by a resolution of the Committee of Health, of date 18th January, 1875, to this effect: "The attention of the Committee having been directed to the evil effects resulting from the occupation of buildings of a certain construction, now being erected in different districts of the city, particularly tenements of dwelling-houses erected on what is known as the hollow-square system, the Committee remitted to a sub-committee of their number, along with the medical officer and master of works, as a special committee to examine these buildings relatively to the width of the adjoining streets, and open spaces inside of these squares, and to report what steps should be adopted by the Board in reference thereto."

I shall not occupy your time with any details of the defects in the powers of the local authority over new buildings, noted and reported by this committee. It is enough to state that they were numerous and most important, and that their labours resulted in the appointment of a deputation, which waited upon the Home Secretary and Lord Advocate, and strongly represented to the Government the necessity of statutory provision for the enforcement of a uniform system of building regulations in the cities and large towns of Scotland, and beyond the boundaries thereof, within a certain defined radius from the centres of such cities and towns, according to their population and area. The important lesson which I wish to impress upon your minds is this, that to enter upon any large scheme of demolition of the dense unhealthy areas of large towns, without first looking narrowly into the existing building regulations, is to adopt a course which necessitates extensive reconstruction and erection of new buildings, without a sufficient guarantee that they shall not, in any degree, reproduce the evils of the old, and, indeed, shall be in all respects the best that the most advanced sanitary requirements can demand. Let the example of Glasgow, therefore, be a warning to other communities. A full quarter of our total inhabited houses has been erected since 1866, when our Improvement Act was passed; and of that quarter, 93 per cent. were dwellings of one, two, or three apartments. Yet while we have enforced all the powers we possess of regulating those new buildings, and while they are undoubtedly improvements upon the old, we confess that we have let slip a golden opportunity of erecting a model city.

The operations to which I refer have enhanced enormously the value of property in the city, and of land suited for building purposes in its neighbourhood. The tendency of both is always upwards in the vicinity of towns; but the artificial stimulus of those extensive central clearances, and the outward pressure caused thereby have, in Glasgow, added to house property and land all at once a marketable value which in ordinary circumstances would have been the slow increment of years In this way the great problem which presents itself at the very outset of any attempt to provide working-class houses on commercial principles has been rendered still more difficult of solution. I mean the value of land, the primary cost of sites for buildings, and the difficulty of so planning our buildings as to secure a sufficient return upon capital, and yet not overbuild and overcrowd the soil. It seems to me that the question of the health of towns has now passed into the hands of the architect, the engineer, and the capitalist. Speaking, for the moment, in a representative sense, I do not feel called upon to be architect, and economist, and hygienist all in one. In the latter capacity I am prepared to lay down general principles, and to criticize and approve; and unless it be that architects cannot draw plans which will satisfy both the hygienist and the capitalist, I see no reason why I should be asked to do more. If you go out into the clear for your building ground, there is no doubt my demands will be more easily satisfied; but you must persuade the people to go thither; you must get manufacturers to transfer their factories, foundries, and workshops to the outskirts, where they would, in these days of private telegraphs and railways, be nearer the town counting-house than they were half a century ago; and you must facilitate the means of bodily transit between the town and the country. If you desire to make a trial of the dearer city soil, then you will find my requirements more stringent, and my conditions more difficult to combine with profit. However the task of providing healthy houses is to be accomplished, I believe our knowledge of the conditions of health is sufficiently advanced, and our conviction of their practicability sufficiently clear, to warrant the Legislature to take the same position as in the case of trade nuisances, and say, These are our conditions, and you must comply with them. It was never intended that cities must either cease to grow or become huge sarcophagi, because architects and engineers could not satisfy the hygienist on the one hand, and the capitalist on the other.

In addition to the area of which they became proprietors in the course of their operations, the Improvement Trust also purchased two small estates on the outskirts of the city, which they disposed of in the ordinary way for the erection of working-class houses. In drawing the building plans they availed themselves to some extent of their position, as superiors, to set aside free spaces, to control the arrangement of the building blocks, and otherwise to illustrate the power which the original holder of the land possesses of giving a healthy constitution, so to speak, to the new quarters of towns.

The Flatted Tenement in Model Dwelling-houses.

It is somewhat remarkable that, in the endeavour to work out this problem of house accommodation and high-priced land, you, in the south, are turning with favour to the flatted system of tenements, on which we in the north look with misgiving. It requires no great consideration or exercise of ingenuity to discover that the simplest way to solve the problem of dear land is to build upwards into the air. Still you will readily understand that the public of Glasgow, paying a yearly tax to disperse densities averaging 800 to the acre, convinced that they were building houses too tall, and packing them too closely in districts which did not carry above a fourth of that number, and only just recovering from the alarm of a death-rate of 66 under the smothering blanket of the previous winter's fog, were startled in the spring of 1875, when news was brought to them from London, that people were being exhibited there, living in tall tenements like steeples, seven flats high, and 1600 to the acre. You may fancy with what eagerness and anxiety the officials and members of the Corporation seized the first chance of being in the metropolis to go and see this wondrous sight. I must add that when the Chairman of our Health Committee, our Master of Works, Dr. Gairdner, late Medical Officer of Health, and myself, looked upon those erections in Farringdon Road, we recognized too much of the features of the High Street and Saltmarket, to take readily to the belief that we saw before us a solution of the question of house accommodation for urban communities. Still, a rash inference or a misleading statement, uttered with authority, often gives much trouble to persons who are striving for a principle; and from the amount of attention which the above statement has attracted in Glasgow, it seems worth while to look narrowly into it. I wish also to add, that while reference is made to one set of model dwellings alone, I have various others in London, such as the Peabody, Corporation, Waterlow, &c., in my mind also, to which in different degrees the same criticisms apply, as in the case of the buildings specially quoted.

In February, 1875, Mr. Charles Gatliff, Secretary to the Metropolitan Association for Improving the Dwellings of the Industrious Classes, read a paper before the Statistical Society of London "On Improved Dwellings and their Beneficial Effect on Health and Morals, with Suggestions for their Extension." It is an extremely able, exhaustive, fair, and, on the whole, accurate statement of the facts as regards the dwellings of the Metropolitan Association, to which the flatted tenements in Farringdon Road belong. I am anxious that no adverse criticism which I may make shall be taken as depreciatory of Mr. Gatliff's services in compiling such a paper. The Association was incorporated by Royal Charter in 1845, the dividend being thereby limited to 5 per cent. as the maximum. It has provided accommodation for 4150 persons in flatted tenements in London, and for 1150 in cottages in the suburbs, to which gardens are attached. The tenements are built in blocks from five to seven flats in height, standing vertical to the street. The cottages range in size from two to six rooms, and in rent from 5s. to 7s. 6d. per week. The dwellings in flats range in size from two to four rooms, and in rent from 4s. to 9s. 6d. per week. The average density of the inhabitants of those dwellings is 1140 to the acre. At one part of the paper the mortality is said during the last eight years not to have exceeded 14 per 1000; and I have seen this quoted repeatedly, although it is an error, as we find from Table IV. that it has ranged from 15 to 18 per 1000. The birth-rate was 36 per 1000. The death-rate of all London in the same time averaged 24, and the birth-rate was 34½. The financial results are, that for 1875 the maximum dividend of 5 per cent. was paid, and for the five previous years 4½. Mr. Gatliff puts forward, as the leading advantages of the metropolitan dwellings, decreased mortality and disease; less area occupied and greater number of persons provided for, notwithstanding large spaces for recreation and ventilation; the facilities for the detection and suppression of crime.

There are various minor criticisms which occur to me upon this paper, which I may rapidly mention before proceeding to the main question of principle involved. The average death-rate of those model dwellings in eight years is 16 per 1000, calculated from Mr. Gatliff's data; but you will observe these are derived from all the buildings, urban and suburban, making twelve widely scattered groups of persons. It is eminently unsatisfactory to test such a system of building as the flatted tenement, by including with its statistics those of self-contained cottages with gardens, which every one admits must be a sanitary Arcadia. After all, we have no assurance that all the deaths fairly referable to those tenements are included. In the discussion at the Statistical Society, a member "begged to submit that the death-rate was entirely fallacious, inasmuch as a considerable number of the inmates of these model lodging-houses died in the hospital." I put this by letter to Mr. Gatliff, and find that this has not been inquired into; but he argues that his tenants are less likely to go to hospitals than those of inferior property in London, and that therefore his death-rate, if not absolutely correct, is sufficiently so for comparative purposes. It is a pity that, in a paper on which so much labour has been spent, a flaw so serious should exist. Isolated blocks of buildings, standing in districts widely separated, cannot be compared with districts, unless this matter of hospital deaths has been settled. The district generally contains a hospital and a workhouse; and the block of building, whether it retains all its cases of sickness or parts with a few to an institution, has an obvious unfair advantage. This is altogether apart from fundamental objections to such a test of mortality or comparison in any respect subsequently to be taken. Another circumstance to be discounted from the value of Mr. Gatliff's death-rates is the process of selection of the population from which they are derived. In his own words, "the inmates of these model houses always undergo a twofold process of selection; that is to say, the inmates first select the model lodging-houses as harmonizing with their own decent tastes, and are then chosen from a larger list of applicants, according to the discretion of the managers of these institutions." In short, the inmates as well as the houses are models; and from this assorted population we are asked to make inferences applicable to the mass of a city population, or rather to the residuum who are cast aside in this process of selection, and in whose ranks we shall find the very people who are the source of our perplexity, and for whom we are most anxious to provide. They have not the senses requisite for the discovery of the comforts of such dwellings, but the possession of which leads the skilled workman, the clerk, and the warehouseman towards the exotic circumstances of the model dwelling-houses, where, in the words of a valuable Report of the London Charity Organization Society, "philanthropic agency supplies one of the chief necessaries of life—viz., lodging—below its market value." Mr. Gatliff gives the occupations of his tenants. I find among the tenants of the flatted tenements only 5 per cent. designated as "labourers," and 2½ per cent. as "charwomen;" the remainder are tradesmen and other persons who under any circumstances, at any rate in Glasgow, would have provided themselves, without the aid of an association, with the best article in the way of house accommodation to be had, at its full market value. There is yet another circumstance in the way of discount to be mentioned, and that is the supervision and discipline to which this model population is constantly subjected. Again, to quote Mr. Gatliff, "at each of these establishments a superintendent resides, to collect rents, supervise, and make himself generally useful; and there is a labourer to execute repairs, also residing on the premises. These men, in performing their duties, become acquainted with the tenants, their occupations and pursuits, and soon detect any drunkards, brawlers, prostitutes, receivers of stolen goods, or other bad characters, who occasionally resort to improved dwellings to evade suspicion." I only ask you to consider what influence on the health as well as the morals of almost any sort of property would be exercised if the landlords set themselves thus to eliminate "all drunkards, brawlers, prostitutes, receivers of stolen goods, or other bad characters."

But the point to which I wish most particularly to direct your attention is the imperfect and fallacious ideas of density which pervade Mr. Gatliff's paper and underlie his inferences; for example, in such a passage as this: "When we consider the diminished rates of mortality and disease which accrue to the tenants in them, notwithstanding that the average population is at least four times more to the acre than in the most densely populated parts of the metropolis, we have an irresistible argument in favour of the increase and extension of this class of buildings. In Westminster, which is the most densely populated part of the metropolis, the population is only 235 persons to the acre; whereas in the dwellings provided by the Metropolitan Association, including in the areas the large court-yards and gardens attached, the average is 1140 to the acre; and yet the rates of mortality and disease are at the low figures just stated." In a foot-note, it is added: "In one instance (that of the Farringdon Road Buildings) the population is 1625 to the acre."

The Doctrine of Density in relation to Health.

It will be necessary for us to endeavour to form some clear conception of the doctrine of density in relation to mortality. It is not necessary now-a-days to prove that there is such a relation. From the date of the publication of the first of Dr. Farr's annual "Letters to the Registrar-General," appended to the Report for 1838, the fact has received yearly accession of proof and illustration. In the fifth Report, on the basis of four years, Dr. Farr showed that the relation was so exact that it could be formulated thus: The mortality of two places is as the sixth root of their densities; and the mortality, calculated from this formula for certain districts during those years, is shown to be identical with the actual mortality. This rule, however, has not been found to apply to the decennial statistics of 1841-50, 1851-60, and 1861-70; but in each period the law prevails, that "there is a constant increase of mortality running parallel with the increase of density." The fact of density may be expressed in various ways: as persons to a certain unit of superficial area, *e.g.*, square miles or acres; or as so many units of superficial area to a person; or both modes of expression may be combined in the proximity, which is as the square root of the density. But this is a mere matter of terminology. What we wish to ascertain is this: What is the essence of this relation between density and death-rate? What is the fact in Nature involved therein? and what is the broadest expression we can give to it? It seems to me to be the numerical expression of the fact that there are limits to the self-purifying powers of Nature; that the laws of Nature, to which we trust for the purification of earth and air and water from the contaminations of animal life, are effective under certain conditions, with which aggregation interferes when it exceeds a certain proportion to the area occupied. The oxygenating powers of the ground-air are overmastered; the ground-water becomes impregnated with unreduced organic matter; the rivers are loaded with impurities; the cycle of interchange and co-operation of the animal and vegetable kingdoms is interrupted; the action of the law of diffusion in the atmosphere, and the influence of light and heat in promoting chemical change and mechanical mixture and dispersion, are crippled. These propositions are, theoretically, simple expressions of fact; but in various ways, when we come practically to illustrate their meaning, they become involved with so many modifying variables, that it is only by supposing simple cases, and introducing synthetically these variables, we can as it were build up before our minds the conditions under which we find populations living, and show through them all the operation of one law. This is the secret of the failure of Farr's law, that the mortality of two places is as the sixth root of their densities. We can modify the influence of density by certain sanitary expedients. Let us imagine a community or a series of districts with a density unchanged for a decade; the population stereotyped in their occupations, character, proportion of ages and sexes, etc., but advancing in their understanding of those laws of Nature which govern the action of density. By drainage they will lower the level of the ground-water, increase the proportion of ground air, and so increase the power of the earth to cope with impurities. By sewerage they will convey to a distance their local filth, and so diminish the impurity with which the soil has to deal. They can make themselves entirely free of all local influences of the ground-water by leading into their midst a domestic water supply from a distant source. Air they cannot directly bring from a distance; but it will be purified to some extent by the same means which promote purity of earth and water, and still more by restoring as far as possible those conditions under which pneumatic laws obtain the freest scope, by removing mechanical obstructions to diffusion, to the access of light and the free play of winds, and by calling in the aid of vegetation. Suppose all this done, and we have a series of districts with their density unchanged, but with their mortality diminished. If all the districts have made equal sanitary progress, the same relation of density and mortality will be apparent; but if they have advanced unequally, then this relation will be entirely overthrown. A case the very opposite of this may be imagined, in which a series of districts may be stagnant as regards every condition of their existence saving their density. They may spread themselves out to the density of rural districts, or rather in that direction; and the more nearly they approach that degree of tenuity of population, the more will their death-rate approach the rural standard. Yet another case may be supposed, in which, while the density and the general sanitary expedients are the same, the character of the population, their occupations, proportion of ages and sexes, etc., are revolutionized, and individual effort in the combat of circumstances is introduced. In that case we should again have a lower death-rate, apparently inconsistent with this great law of density, but in fact proving this, that the same degree of aggregation is more destructive of one class of people than of another; that the habits of some people sooner than those of others break the laws on the observance of which a certain degree of health may be had—laws which become more exacting with every increase of density.

It will be apparent from these synthetic illustrations that, in studying the influence of density as we find it, we must remember the infinitely variable combination of circumstances in and through which it acts, and prepare to meet inconsistencies, which will disappear only after a careful analysis of these circumstances. But of this we may rest assured, that, whenever two communities are absolutely comparable in all respects save that of the density or proximity of their vital units, the more dense will be the more unhealthy, above that, as yet, undetermined limit at which the element of density becomes measurable as a factor; and if two communities be of like density, but differ in health, then we shall find in the one circumstances which intensify the morbid influences of density, or in the other circumstances which compensate and neutralize them. Here, then, we are introduced to the practical aspect of the doctrine of density. Concentration of vital units is one of the features of civilization, and an essential condition of its highest development. The point to be determined in this concentration is, that where the maximum of common advantage is reached, and where deterioration and morbid influences begin to exceed; and that nation will reach the highest level, and, what is still more important, longest maintain its place there, which succeeds in discovering and preserving the maximum of concentration consistent with the minimum of deterioration.

We can now return to the Metropolitan Association. In the passage which I quoted Mr. Gatliff contrasts the density and mortality of Westminster with what he calls the density and mortality of his dwellings. In the former we have 235 persons per acre and a mortality of 23 per 1000 (the average of the decade 1851-60, for Westminster registration district); in the latter we have 1140 per acre and a mortality of 16 per 1000—nay, we have even 1600 per acre in one building, and yet, see what material advantages remain. The question of whether 16 is or is not the mortality is of little moment. We have at present to ask, is this a logical comparison? and I have to answer that it is not. An essential condition of the notion of density, and an element which enters into its very definition as a law, is not the rate, but the area over which the rate prevails; and that area must be a continuous area, not formed of patches only brought together upon paper for statistical purposes. But Mr. Gatliff takes bits of land dotted all over the metropolis, with the flatted tenements thereon, and his cottages in the country with their gardens; adds together their area and population, finds that the proportion is 1140 to the acre, calls it their density, and then contrasts this with the density of between two or three hundred continuous acres in Westminster, and, by implication, with all that we know of the relation of density and death-rate, as illustrated in three decades of the Registrar-General's Returns, derived from square miles of country, urban and rural. Could anything be more fallacious? The fact is, the density of those buildings and cottages is simply that of the district in which they stand, if taken individually; and, if collectively, that of the metropolis as a whole, viz., 45 per acre. If you have 800 people living on half an acre of ground in the middle of Hyde Park, that does not mean that they are living at a density of 1600 per acre; they are living upon the bounty of the surrounding acres. If such a block of buildings were transported into the midst of a semi-asphyxiated city, such as Glasgow, where every patch of soil has already been utilized, and the general stock of air is poor, the death-rate would soon adjust itself to the actual density. In short, we may be sure that, while the seven-flatted tenement, carrying 1600 per acre of the area of its own site, may be a satisfactory solution of the difficulty of ground rent and cheap house accommodation, between the architect and the individual capitalist who holds the ground or builds the tenements, it would be ruinous for the health of the community if applied to a large area, and intolerable, unless the Government or the local authority provided lungs in the shape of free space, on the bounty of which the tenants would live.

A few minutes ago I referred to Glasgow as a "semi-asphyxiated city," and I used the term with deliberation, as I believe that it is on the quality of the air that density of population most certainly tells. The influences on earth and water may be combated and diminished with comparative ease; but it is to a great degree inevitable that, except in so far as purity of air and water lessen the impurity of the air, density must carry with it aerial contamination. In cities we have a conjunction of circumstances, all which co-operate to throw an excess of impurity into the air, and also of circumstances which obstruct and impair the natural arrangements for the reduction of those impurities. Just let me give a few details of my own city relative to this matter. What is called Glasgow, and for municipal and statistical purposes is embraced under the name, occupies an area of 6033 acres, of which, we may say, 1000 are unbuilt upon, but available for building; while 282 are devoted to public parks, and 137 are graveyards, of which 120 are still in daily use. On the remaining 4614 acres there were congregated, in 1875, 534,560 human beings, of whom three-fourths lived in dwellings of one and two apartments; 8200 horses in 2300 stalls; 1770 cows in 330 cow-houses; 1370 pigs in 140 piggeries. Each of these collections of animals has its attached heap of manure or refuse; the human animals having 7000 ashpits, or ashpits and privies with pans, the superficial area of which, at a moderate computation, will be 4¼ acres, and probably a third of this area is covered with a mixture of night-soil and ashes or night-soil alone. The emanations of this area are more injurious than if it were really continuous, as these ashpits and privies are all situated in confined courts, or inside those hollow blocks in which the Glasgow tenements are always built. Add to this the products of combustion of coal, poured out from hundreds of factory chimnies and thousands of domestic vents, and of some sixteen hundred million cubic feet of gas which is consumed, besides three million cubic feet which leaks into the soil. Then look at the hindrances thrown in the way of nature by our block-buildings, which are so many boxes of stagnant air; by our back buildings standing inside those boxes; by our narrow streets and tall tenements; and at the subversion of the cycle of nature by the abolition of vegetation, partly through our avarice of the soil, which will not leave a yard to its natural uses, if possible; partly through the impurity of our atmosphere, which kills all trees, and in some places even grass, so that the influence of Glasgow is like that of a flight of locusts, it leaves not a green thing behind. Can it be a matter of surprise that bronchitis, consumption, and other diseases of the lungs constitute, year by year, from 31 to 38 per cent. of our entire mortality? The same fatal prevalence of pulmonary disease attends all urban communities, more or less; and when the sources of mortality are compared with the density of large areas over decades, it is found that they show characteristics consistent with, and proportioned to, density. Sometimes, this tendency to asphyxia in our large cities is brought out in an appalling manner by passing physical changes, which temporarily intensify all those obstacles to the purifying efforts of nature which we have enumerated. Such are the effects of combined cold and fog, of the influence of which an illustration was furnished in London in December, 1873, when the death-rate was pushed up to 38, and the cattle in the Christmas Show at the Agricultural Hall died in great numbers, manifestly choked. But more shocking was our own case, in December, 1874, when, during a ten days' continuous fog, ending on the 31st of that month, the death-rate of Glasgow reached the unprecedented point of 69 per 1000 in the week ending January 2nd—this rate being calculated from the date of death, and not merely from that of registration, which at such a season may be unduly deferred. And what were the causes of those deaths? Of the total 700 no fewer than 372 were pulmonary; only 107 were zymotic, and the remaining 221 were from other general causes. Hence, simply by drawing the curtain of the fog over a city during a time of intense frost, it is possible, under those circumstances of constantly impaired aeration of its organic effluvia, to well-nigh stifle it, and cause a mortality to which zymotic disease contributes comparatively nothing; and which, indeed, it seldom occasions under such degrees of prevalence of pestilence as are known in modern times in the temperate zone.

Effects of Density on the Composition of the Air.

We are thus led up to the consideration of an exact measurement of density as a factor in relation to health. The simple numerical statement is subject to so many modifications by association with varying conditions in the other circumstances of the vital units, that it is very desirable to obtain some compendious exact expression of the meaning of density in each case. This would probably be afforded by analysis of the air. So far as density of population is a factor of disease, it must have a corresponding density of air, and thus the chemist could detect where, under given circumstances, we pass from a degree of density consistent with health in those circumstances to one productive of disease. This idea was floating in the mind of Dr. Farr in 1843; but he says, at that date, "chemists have hitherto failed to detect any excess of carbonic acid in cities," a statement which, though not historically correct, inasmuch as the younger De Saussure had, in 1827, clearly established a difference between the air of Geneva and of the fields outside that town, is indicative of the position of chemical analysis as practically applicable to the solution of the hygienic relations of the air. I need not remind you that, through the laborious investigations of Dr. Angus Smith, the most important of which were expended upon the air of the neighbouring city of Manchester, the outlines of the chemical climatology of cities have been clearly drawn, and the chief difficulties of method have been overcome. When we recollect the special provision made by the laws of diffusion of gases for the dispersion of carbonic acid, we can estimate the importance of the establishment of the presence in excess of that gas in the atmosphere of cities. It prepares us to expect the presence also of foreign ingredients in the shape of solid particles of animal and other matter, which, unaided by pneumatic laws, depend for their dispersion upon mechanical transport by the fluid medium in which they are suspended. It is to this atmospheric dust, and the products of that portion which is organic, that modern pathology leads us to attach most importance, and also that modern chemical processes have made most advance in their power of estimating. The mechanical obstacles to the effective operation of the laws of diffusion which accompany density of population, tend to the accumulation in the lowest atmospheric strata in which we live of a microscopic sediment which is both mechanically injurious to life, and productive of chemical deterioration in the quality of the vital air.

I have long thought that the most important aid which chemical science could furnish to public health would consist in the systematic publication of analytic reports on the quality of the air we breathe, similar to those which are habitually furnished of the water we drink. It is not so very long ago since we became familiarized with the fact that water differs in its intimate composition to a degree beyond the powers of our finest senses to detect; and the greatest possible advance in our exact knowledge of the conditions of health would follow a like familiarity with the fact, that chemical analysis can weigh and measure degrees of difference in air which are totally inappreciable by unaided sense. Angus Smith says—"It was a great day for the world when air was found to be something material, and to be capable of weighing down the scales of a balance;" but what he says in the previous sentence—"when we are children air is nothing"—is nevertheless true of the ordinary thoughts and conceptions of air current in the minds of the general public, whose intelligence is really the measure of sanitary progress. It is not what Angus Smith teaches, but what our mayors and aldermen, provosts and magistrates believe, and have some rough practical apprehension of, that will sustain and give effect to a medical officer's denunciation of overflowing middens, building in hollow squares, narrow streets, unconsumed smoke, and those other details which contribute to the great sum of aërial deterioration.

A short while ago, at my suggestion, the Health Committee of Glasgow resolved to give some assistance in the analysis of the air, in the healthy and unhealthy parts of the town, to Mr. Dixon, a gentleman who placed his personal services at our disposal without fee or reward. He has expended much time, ingenuity, and skill in devising an apparatus for the collection of the impurities of a large quantity of air in a short space of time. Even if it were prudent, at this stage, to enter upon any description of his arrangements, or account of his analytic processes, I should only spoil an interesting subject through lack of chemical knowledge. Mr. Dixon will probably be in a position to make some provisional communication on the subject at the meeting of the British Association in Glasgow in September next. The quality of their air is well worth the attention of all large towns. The chemist seems now quite able to cope with all the most important foreign ingredients, as well as with the minute variations in the proportion of its normal constituents. What he requires is such aid as public funds alone can provide. We may shortly expect some interesting and valuable results from the city of Paris, which, in April last, resolved to devote an annual sum of 12,000 *francs* for meteorological observations in various districts of the city. They are to be carried out under M. Marié-Davy, director of the Observatory of Montsouris, on the outskirts of Paris, and, besides the ordinary facts of meteorology, are to include atmospheric electricity and the comparative composition of the air. Before receiving this commission from the municipality of Paris, M. Marié-Davy, had been gradually introducing air-analysis into the routine work of the observatory, both directly by automatic continuous air-washings, and indirectly, by the analysis of the rain-water. The special design of those investigations was to contribute to the scientific knowledge of agriculture; but now, in their extension to numerous stations in Paris, they cannot but yield results of importance to a scientific knowledge of hygiene. Since 1865, indeed, ozone estimations have been continuously made at twenty different stations in that city, of the results of which M. Marié-Davy gives a diagrammatic summary in the monthly report of his observatory for May last. From this it appears that, while ozone abounds towards the periphery and in the open parts of Paris, it is present only as a trace in the denser central quarters. The fact of the recognizable presence of ozone, even in the populous parts, is something to boast of. The contents of the Montsouris monthly reports are very interesting. Much attention is being given to the photographic delineation of the microscopic particles of the atmosphere, as well as to the products of culture experiments with the living organic portion; and it looks like progress in the right direction to find a systematic table of "Matters contained in the air and rain" of each month, showing opposite each day, for the period of the day and the night, the proportion in 100 cubic *mètres* of air, of ozone, carbonic acid, ammonia, nitric acid, and organic matter, and per *litre* of rain-water, of ammonia, nitric acid, saline residue, and organic matter. Similar systematic information, collected at different points in the same city, will soon supply a solid structure of fact regarding its comparative hygienic conditions. The next step in the use of air-analysis will be as evidence in the enforcement of sanitary work, in matters of ventilation, defective structure, and nuisance removal, which at present are decided on the evidence of the senses or of experts, authorities which may differ. We have only to imagine that, to prove the impurity of the water of a well sunk in the neighbourhood of a cess-pit, we were deprived of the assistance of chemistry, to understand how great is the want of this assistance in the parallel case of air in alleged pollution from whatever cause.

Now, gentlemen, I have taken you over a considerable range of subjects, beginning with the endeavours of the authorities of Glasgow to improve the condition of their poorer citizens, passing through a discussion of the doctrine of density in relation to health, and ending with a reference to the important information to be anticipated from systematic air-analysis in crowded districts, as a key to the real truth in nature expressed by this doctrine of density. Laws of wide action may be lost sight of by the very scope of their influence; and if I have succeeded in convincing you that, however we may modify the effects of density upon health, they still exist, and are measurable in comparable circumstances, then the design of my remarks has been attained.